[3.0019]

# BIONOMICS OF THE BARK BEETLE PREDATOR, *Temnochila virescens* Mann. (Coleoptera: Ostomidae) [1]

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Many species of Ostomid and Clerid beetles are well known predators of bark beetles; consequently, the adults of these insects are commonly observed on the outside bark whereas the larvae inhabit the inner-bark of trees infested with bark beetles. Inasmuch as Ostomid and Clerid beetles are usually the most abundant insect predators of bark beetles and because only a few intensive studies have been made on these insects it was thought desirable to evaluate the effectiveness of two species of these common predators, *Temnochila virescens* Mann. and *Thanasimus dubius* (Fab.). Therefore, a study of these relationships was undertaken in 1964 and conducted over the following two year period, 1964-1966.

Part of these studies entailed collecting a considerable amount of information on the life history and ecology of these predators and for one of these, the Ostomid beetle, *Temnochila virescens*, the results are presented in this paper. Another paper (Mignot and Anderson, 1969) deals with the Clerid beetle, *Thanasimus dubius.*

The only intensive past studies of Ostomid beetles as predators of bark beetles were those of Struble (1942a and 1942b). These also dealt with *T. virescens* but the host prey was the mountain pine beetle, *Dendroctonus monticola* Hopk. The result of these studies were somewhat similar to those presented here.

In a third paper, which is scheduled for future publication, the potential effectiveness of both *Temnochila virescens* and *Thanasimus dubius* in regulating bark beetle populations will be discussed.

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## Methods of study

Both field and laboratory studies were used. Ten pines (*Pinus taeda* L.) were felled in each of twelve different areas of the Duke University Forest which is located near Durham, North Carolina. These trees were cut at four different times during the year–spring (April), early summer (June), late summer (August), and fall (Spetember). This experimental design resulted in infestations by bark beetles, mostly the pine engraver, *Ips grandicollis* (Eichh.) and to a lesser extent *I. avulsus* (Eichh.) and *I. calligraphus* (Germ.), at various times during the warmer seasons so that activities of the predators could be followed in the field. These felled trees were observed periodically to determine the presence of infestations by the pine engravers and the associated predators. Starting three weeks after each group of trees had been cut, and continuing thereafter at weekly intervals for a period of twelve weeks, bolts two feet long were cut from the boles of the felled trees. The bark was removed from these samples so that the *Ips* and predators present in the inner-bark could be identified, counted, and their developmental stage determined.

In the laboratory the predators were reared in Petri dishes. The inside of the bottom plates were usually covered with moistened filter paper so as to produce moisture conditions similar to those in the inner-bark where the immature stages of the predators normally live. The larval stages of the predators were fed with larvae and pupae of the pine engraver beetles (*Ips* spp.) while the adult predators were fed with adult engraver beetles. Various constant temperatures were

**Table 1.** Length of the developmental periods for the predator *Temnochila virescens* and its host, the pine engraver, *Ips* spp.

| Insect Species | Time of Year | | | |
|---|---|---|---|---|
| | Spring | Early Summer | Late Summer | Fall |
| | | Days | | |
| *Ips* spp. | 34-37 | 31-35 | 33-35 | 32-34 |
| *T. virescens* | absent[1] | 89-91 | 254-258[2] | absent[3] |

[1] Only adults were observed on the outside bar, larvae and pupae were not found.

[1] Only adults were observed on the outside bark, larvae and pupae were not found.

[2] The long developmental period was because the larvae passed the winter in this stage.

[3] Neither adults nor larvae and pupae were found.

used for the laboratory studies. A small piece of pine bark had to be placed with each pair of reproducing beetles. This material provided a suitable place for egg deposition.

## Results

The field data collected on the life cycle of the Ostomid beetle, *T. virescens*, are summarized in Tables 1 and 2, whereas similar data collected in the laboratory are presented in Table 3. Mortality data for the developmental stages at the various temperatures are presented in Table 4.

Longevity of the adults when kept separately in Petri dishes varied from 115 to 194 days. Longest survival occurred at 30° C and the shortest at 20° C. The averages and standard errors for the five replicates used for each of the five temperatures were as follows: 20° C, 131± 4.7 days; 25° C, 165± 6.8 days; 30° C, 179± 5.4 days; 35°C, 176± 3.7 days; 37½° C, 153± 3.4 days.

The average preoviposition period from the time of beetle emergence to when the first egg was laid varied from 31 days at 30° C to 48 days at 20° C. The length of time was 34 days at 25° C, 35 days at 35° C, and 43 days at 37½° C. Five replicates were used at each temperature studied with the range for each varying from 29 to 34 days at 30° C to 42 to 56 days at 20° C. Subsequently, the oviposition period continued for 83 days at 20° C to 148 days at 30° C.

Total egg production for pairs of these predators varied from 81 to 216. The average number of eggs per female for the various temperatures were as follows: 20° C, 81 eggs; 25° C, 157 eggs; 30° C, 216 eggs; 35° C, 184 eggs; 37½° C, 118 eggs. These were produced at an average rate of 6.8 to 10.2 eggs per week.

Moist conditions appeared to be better than a dry environment for larval development. The total mortality was 58.4 percent when the insects were reared on dry filter paper, but was only 36.9 percent when the paper was kept moist. A total of 100 larvae were used in this study.

Whenever two *T. virescens* larvae were enclosed together in a Petri dish, one commonly killed and ate the other. Even when other food (bark beetle larvae or pupae) was present, cannibalism was still rather high (80 percent) during the test period of one to two days. When bark beetle larvae or pupae were lacking one larva always destroyed the other. The adult beetles, on the other hand, were cannibalistic about two-thirds of the time but only in the absence of their usual food.

In the field, the density of the *T. virescens* populations, on the outside of logs infested with pine engravers was constant during the spring, early summer, and late summer (averaging 1 beetle per 3 square feet of bark). In the fall, this species of predator was absent from the outside of infested logs. Larval populations of the earlier instars of this predator averaged 1 per 2 square feet of inner-bark surface during both the early summer and late summer seasons. However, this density decreased as the larvae matured so that for the last (6th) larval instar and the following pupal stage there averaged only 1 insect per 3 square feet of inner-bark. As can be seen from the data in Table 1, there were no immature stages of *T. virescens* present in the logs infested with *Ips* spp. during the cool spring months of April and May. Throughout the autumn this predator was also absent in those logs that had been cut in September and only recently attacked by *Ips*. Older *T. virescens* larvae, however, were present throughout the fall in the inner-bark of logs that had been cut and infested earlier in the summer (June and August).

**Table 2.** Development of *Temnochila virescens* in the field

| Time of Year | Instar[1] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | Pupal | Total |
| | Days | | | | | | | |
| Early Summer | 3 | 6 | 13 | 37 | 5 | 6 | 16 | 86 |
| Late Summer | 3 | 7 | 13 | 196[2] | 5 | 5 | 16 | 245 |

[1] Development of the egg stage was not followed in the field.

[2] Extended length of time for fourth stadium was because the insects passed the winter in this instar.

## Discussion

The data presented in Tables 1 to 4 show that the bark beetle predator, *T. virescens*, developed fastest and survived better at the warmer temperatures that occur during the summer season. This species apparently was unsuccessful in establishing broods during the cooler periods of spring and fall. Immature stages were absent in logs exposed in the field and initially infested with bark beetles in April and September even though the adult predators were present during the spring. During the cooler months this ecological niche in the inner-bark was consistently occupied by another common predator, *Thanasimus dubius* (Mignot and Anderson, 1969).

As with most preliminary types of studies, the present one suggests several relationships that should be investigated more thoroughly. One aspect that needs clarification is to determine why the immature stages were absent during the cool spring and fall months. As stated previously, the inner-bark of logs infested with bark beetles during both spring and fall was occupied by another predator, *Thanasimus dubius.*

From the data presented it is obvious that *T. virescens* has only one generation per year in North Carolina. Winter was passed in both the larval and imago stages.

It also should be noted that the rate of development decreased greatly at temperatures below 30° C. At 30° C the rate of development from time of oviposition to the imago was 38 and 63 percent faster than it was at 25° C and 20° C respectively. This adverse effect of cooler temperatures agrees with the other results indicating that this predator succeeds better at higher temperatures. However, as can be seen from the results in Table 3, extremely high temperatures also repressed the speed of development. At 37½° C and 35° C the rate of development was 42 and 22 percent slower for the two respective temperatures than at 30° C.

And, lastly, the interspecific relationship between the two predators, *Temnochila virescens* and *Thanasimus dubius*, should be investigated more thor-

**Table 3.** Development of *Temnochila virescens* at various constant temperatures

| Stage of Development | Temperature °C | | | | |
|---|---|---|---|---|---|
| | 20° | 25° | 30° | 35° | 37½° |
| | | | Days | | |
| Egg | 18(1.3)[1] | 14(1.4) | 9(0.5) | 7(0.2) | 10(0.9) |
| Larval Instars | | | | | |
| 1 | 17(0.8) | 9.5(0.8) | 6.5(0.2) | 4(0.3) | 10(0.7) |
| 2 | 21.5(1.2) | 15.5(1.2) | 6.5(0.4) | 7.5(0.2) | 8.5(0.5) |
| 3 | 61(4.6) | 54.5(6.1) | 16.5(1.7) | 10(0.9) | 25(1.5) |
| 4 | 118(4.7) | 50(3.1) | 55(4.3) | 51(3.0) | 65.5(4.8) |
| 5 | 22(1.3) | 11(1.5) | 4.5(0.5) | 14(1.8) | 20(3.3) |
| 6 | 10(0.7) | 7(0.3) | [2] | 21(1.0) | 23(1.1) |
| 7 | [2] | [2] | [2] | 17(2.1) | 20.5(1.8) |
| Pupa | 24(1.8) | 13(0.3) | 11(0.7) | 6(0.2) | 5(0.6) |
| Total | 291.5 | 174.5 | 109.0 | 137.5 | 187.5 |

[1] Values in parentheses are standard errors. Five replicates were used for each temperature.

[2] No instars occurred at these temperatures.

oughly especially at cooler temperatures. This type of study may help to explain the fate of the Ostomid larvae in the spring and the Clerid larvae in the summer.

### Literature Cited

**Mignot, E. C. and R. F. Anderson.** 1969. Bionomics of the bark beetle predator, *Thanasimus dubius* (Fab.) (Coleoptera: Cleridae). Ent. News, 80: 305-310.

**Struble, G. R.** 1942a. Biology of two native coleopterous predators of the mountain pine beetle in sugar pine. Pan-Pacific Ent. 18(3): 97-107.

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**Table 4.** Mortality suffered by *Temnochila virescens* during the developmental period

| Stage of Development | Temperature °C | | | | |
|---|---|---|---|---|---|
| | 20° | 25° | 30° | 35° | 37½° |
| | | | Percent Mortality[1] | | |
| Egg | 44.0 | 42.0 | 33.0 | 47.0 | 50.0 |
| Larval Instar | | | | | |
| 1 | 10.6 | 10.4 | 9.4 | 11.1 | 19.5 |
| 2 | 5.9 | 4.8 | 4.0 | 3.8 | 3.7 |
| 3 | 3.2 | 2.2 | 2.7 | 1.9 | 1.9 |
| 4 | 6.9 | 3.7 | 1.0 | 1.8 | 2.0 |
| 5 | 7.1 | 4.8 | 1.0 | 1.4 | 1.8 |
| 6 | 6.5 | 4.2 | [2] | 3.0 | 2.7 |
| 7 | [2] | [2] | [2] | 4.8 | 3.3 |
| Pupa | 4.5 | 6.7 | 5.9 | 5.0 | 5.4 |
| Total | 88.7 | 78.8 | 57.0 | 79.8 | 90.3 |

[1] Mortality values for each stage are based on the total population at the beginning (e.g. number of eggs). The number of insects used for each stage at each temperature varied from 19 to 51 with the average being 35.1.

[2] No instars occurred at these temperatures.

2.0019 **Bionomics of the bark beetle predator,** *Temnochila virescens* **Mann. (Coleoptera: Ostomidae).**

Abstract.– The Ostomid, *Temnochila virescens* Mann., a predator of *Ips* spp. bark beetles in the Southeastern United States, develops and survives best during the summer months. In this area this predator has one generation per year, overwintering in both the larval and imago stages. Longevity and egg production are at a maximum while mortality and preoviposition period are at a minimum at 30° C. Both adults and larvae exhibit canni-

balism.– Edward C. Mignot and Roger F. Anderson, *Department of Entomology, Purdue University, Lafayette, Indiana 47907,* and *School of Forestry, Duke University, Durham, N. C. 27706.*

*Descriptors: Ips* spp.; *Temnochila virescens*; bark beetles; predator; Ostomidae; Coleoptera.

## The Entomologist's Record

To encourage the publication of concise and useful new distribution records, corrections of previously published erroneous records, misidentifications, short field notes, and current news items about entomologists, amateur and professional, entomology departments and museums, prompt (monthly) publication is offered in this department.

**3.0033 Neoaplectanid nematodes as parasites of the pales weevil larva,** ***Hylobius pales*****.**– The purpose of this note is to report what is believed to be the first known instance of Neoaplectanid nematodes attacking the pales weevil, *Hylobius pales* (Herbst).

In August 1965, during an ecological study of immature stages of the pales weevil in a stand of lobolly pine (*Pinus taeda* L.) near Raleigh, N. C., 14 sixth-instars and 1 pupa, all apparently diseased, were removed from the roots of one stump. The specimens were turgid but yellowish-brown, as compared with the near-white of normal individuals, and made up about 30% of the weevil population in that stump. All were adjacent to one another on the same root about 5 cm below the soil surface. Approximately 125 additional weevil larvae and pupae were collected from 8 stumps in the same area, but no other abnormal specimens were found. Microscopic examination showed the specimens to be heavily infected with large numbers of an immobile nematode which was identified as *Neoaplectana* sp. by Dr. C. W. Massey, USDA Forest Service, Albuquerque, N. M.

Recent work by Jackson and Moore (1969. J. Invertebrate Pathl. 14: 194-198) showed that infestation of pales weevil larvae under laboratory conditions is feasible, and the discovery of a natural infestation in the field points to the possibility of using *Neoaplectana* sp. against the weevil as a control practice.– H. A. Thomas, *Southeastern Forest Experiment Station, Research Triangle Park, N. C. 27709.*

*Descriptors*: Coleoptera; Curculionidae; pales weevil; *Hylobius pales*; neoaplectanid nematodes; parasites.

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